TRB TRANSPORTATION RESEARCH BOARD

NCHRP-IDEA CONCEPT DIGEST

National Cooperative Highway Research Program

Innovations Deserving Exploratory Analysis Project

Projects 32 and 47 March 1999

Pavement Quality Indicator

The NCHRP-IDEA Project is jointly funded by the Federal Highway Administration, U.S. Department of Transportation, and state highway agencies through the American Association of State Highway and Transportation Officials. In an NCHRP-IDEA investigation, TransTech Systems, Inc. (Peter Sawchuk, Project Manager), in Schenectady, New York, has developed and tested the following new product with potential application to highway systems.

IDEA Product

The density of hot-mix asphalt is an important construction variable in the long-term durability of paved surfaces. In this IDEA project, TransTech Systems, Inc., developed and tested a pavement quality indicator (PQI) system for real-time, in situ measurements of asphalt pavement density. The device provides a nonintrusive, nondestructive, and nonradioactive technique for static and in-motion measurements of asphalt pavement density.

Concept

Current methods of measuring asphalt pavement density have limitations. Laboratory measurement of core samples is time-consuming and costly, and any useful information does not reach the paving crew in time to make corrections to the paving process. The alternative, a nuclear density gauge, requires strict licensing and usage procedures and has other limitations.

In the PQI system, bulk density or the degree of compaction is measured by the response of an electrical sensing field to changes in electrical impedance of the material matrix, which in turn is a function of the composite resistivity and dielectric constant of the material. Since different matrix elements have different resistivities and dielectric properties, the unit is first calibrated to the material being measured. Once calibrated, the density or the degree of compaction may be measured directly. The PQI system has a circular sensing head plate and utilizes a toroidal electrical sensing field (Figure 1). Other components of the system include a microprocessor-based control circuit, battery power supply, numeric keypad for instrument calibration, and digital data readout.

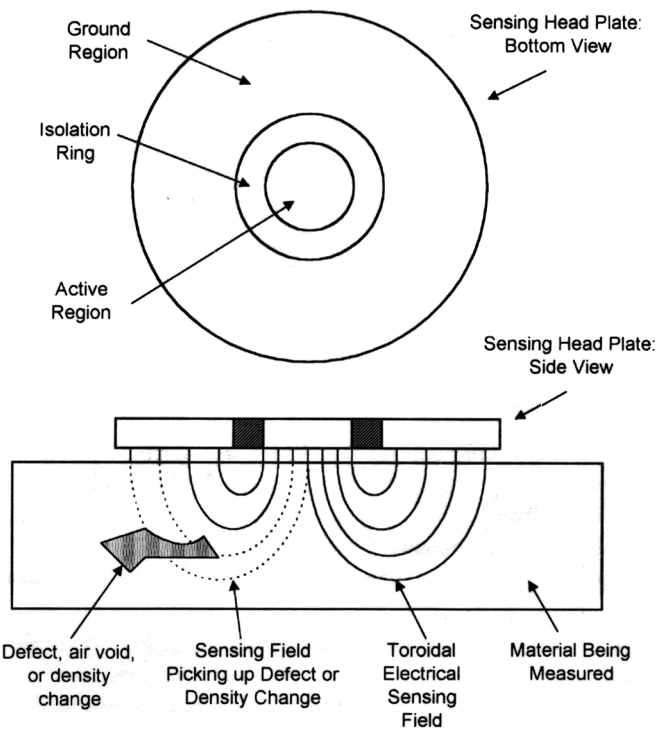

FIGURE Schematic of PQI sensing plate.

Project Results

In NCHRP-IDEA Project 32, the PQI system was shown to be a viable approach for real-time, in situ measurements of asphalt pavement density. In NCHRP-IDEA Project 47, the system was further modified and evaluated in field tests at a number of locations using various asphalt mixes. The test data provided guidance in developing the commercial design of the system.

The following is a summary of accomplishments:

- Instrument measurement and readout information features were established.
- Numerous design changes were made to improve instrument performance.
- Ten preproduction units were built, and a field test plan was established.
- A regional panel of experts reviewed the design concepts and the test plan.
- Five controlled asphalt test mats were constructed with sections of varying density, and verification tests were conducted.
- Field operational tests were performed at eight sites and data from each test were analyzed.
- Design changes were made on the basis of concept review by the regional panel of experts and analyses of test results.
- Preproduction design optimization was performed, followed by debugging of changes and generation of a formal manufacturing design.
- Additional field verification tests were performed, and an additional manufacturing run was made.

Figure 2 shows the initial commercial model of the system. The instrument is small, lightweight, safe, and easy to use. Since no special training or licensing is required, anyone in the paving crew can operate the unit. Pavement density readings are obtained almost instantaneously with excellent accuracy and repeatability as compared with existing alternatives. Table 1 shows results of a typical field test.

Road to Implementation

Initial market research data indicate a substantial potential market for this product—on the order of $100 million.

The ability of the PQI system to instantaneously read asphalt pavement density creates a cost-effective opportunity to significantly increase the number of density readings taken on the highway and provide real-time feedback to the paving crew for instantaneous corrective action. The PQI also might significantly reduce the current core sampling and laboratory analyses that are used to monitor asphalt pavement densities. Development and deployment of the PQI in the asphalt paving industry will yield more efficient paving operations, higher productivity, and better quality control, resulting in longer pavement lifetimes and lower overall life-cycle costs.

Commercialization of the PQI technology has proceeded at a rapid pace. Initial commercial sales and customer feedback indicate acceptance of the PQI in the marketplace, both domestically and overseas.

TransTech's marketing strategy has focused on the PQI as a process tool for the contractor to provide real-time feedback for improved asphalt laydown. This approach is producing an immediate improvement in the quality of asphalt highways while accumulating an extensive performance history that will be helpful in entering other market segments.

FIGURE 2 TransTech Systems PQI.

TABLE 1
Comparison of Asphalt Density Measurements (lb/ft^3) Using PQI and Nuclear Density Gauge (Location: Rt. #3, Bar Harbor, Maine; Mix: Superpave)

Core #	PQI	Nuclear	Core
1	152.6	149.5	146.8
2	144.2	143.5	144.3
3	140.3	141.0	141.3
4	141.3	137.9	139.0
5	139.3	130.1	138.2
6	139.3	136.5	140.6
7	137.9	137.2	140.5
8	140.8	139.7	143.2

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